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HUNTINGTON II Simulation Program—MALAR

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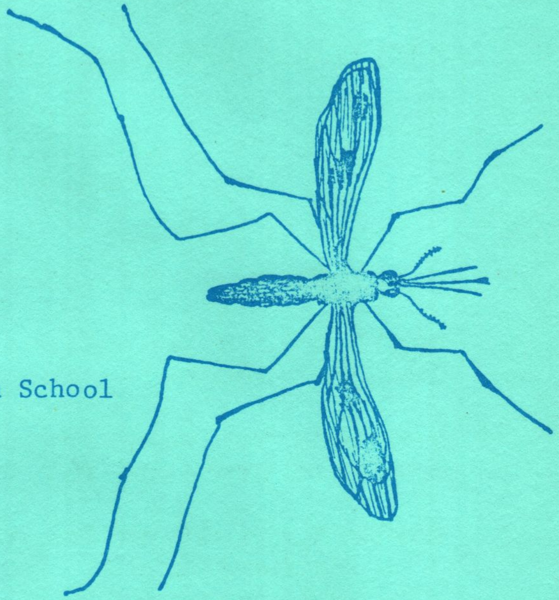
STUDENT MANUAL

MALARIA ERADICATION PROGRAM

MALAR



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HUNTINGTON TWO COMPUTER PROJECT

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MALAR

I. INTRODUCTION TO THE UNIT

This unit focuses on malaria as a classic example of a world health problem. As you work with the materials in the unit and the computer program MALAR, you will learn about the medical and biological aspects of this health problem; but you will not stop there. You will begin to see that such a health problem involves many other kinds of concerns, and you will begin to look at it from points of view you may never have considered before. You will see how a health problem can also be a social, political, economic, and ecological problem, and you will begin to see just how complex is the business of achieving sound health for the world community.

Before you begin the exercises in the *STUDENT MANUAL*, your teacher may want you to spend some time reading or learning about the background materials presented in the *RESOURCE MANUAL* of the MALAR unit. These will give you a clearer understanding of the problem that will be presented to you in the computer program MALAR.

II. DESCRIPTION OF THE PROGRAM

MALAR simulates the *attack* phase of a malaria-eradication plan. It allows you to attempt to eradicate malaria from a given area within five years. You can try to do this with or without a budget limitation.

The conditions you have to work with appear in the "box" on the following page.

APPROX. POPULATION OF AREA: 100000

APPROX. NUMBER ILL WITH MALARIA: 25000

APPROX. NUMBER DEATHS/YEAR DUE TO MALARIA: 1000

GOAL: ERADICATE OR MINIMIZE THE MALARIA INCIDENCE IN THE AREA OVER A 5-YEAR PERIOD.

THE USER CAN MAKE USE OF A 4-TREATMENT METHOD, NAMELY:

1) To isolate in field hospitals those afflicted by malaria

2) To administer drugs to those who are ill

3) To use a pesticide to kill mosquitoes

4) To give preventive drugs to those still healthy

THESE ARE THE APPROXIMATE COSTS:

Field hospital of 20 beds: $2000 per year

Maximum malaria drug treatment: $2/year/person

Full anti-mosquito spray:

When using *DDT* - $ 75000 per year

When using *Malathion* - $231000 per year

When using *Propoxur* - $637500 per year

Preventive drug effective 1 year: 72¢/person/year

(IF USING A BUDGET, YOU HAVE $500,000 TO WORK WITH.)

You are allowed to specify the extent to which you want to use each treatment method during each year of the five-year period. After you enter your decisions for a specific treatment method, the computer will print out the cost of that plan and the total amount of money you have used to that point. If the program is being used with a budget restriction, the computer will print out the balance remaining in the budget. After you have entered your decisions for all four types of treatment, the computer will tabulate the results of your five-year overall plan. It will specify for each year the number sick with malaria and the number of deaths caused by malaria. It will also print out the total amount spent over the five years, and if a budget restriction has been used, it will print the remaining balance. You may then: 1) get an evaluation of the effectiveness of each part of this plan, and 2) continue with the problem for another five years, or 3) start over, or 4) stop the program.

To be considered successful, you must have reduced the number of sick and the number of dead to a minimum.

NOTE: Keep in mind that the number of people who actually are sick in a given year is usually greater than the number given in the printout, since some have usually received treatment.

III. ASSUMPTIONS UNDER WHICH THE PROGRAM OPERATES

When the computer program MALAR was written, these major assumptions were made:

1) The area under treatment has been subject to malaria for a long time and thus a fraction of the population is assumed to have developed a slight resistance.

2) In any one year about 4% of those who are infected will die of complications due to malaria, if they are not treated with drugs.

3) The hospital confinement period for a malaria victim is about 1 year when there is no supply of drugs for treating the disease, and about 7 days when there is a sufficient supply.

4) Drug doses for the ill will be used first in the hospitals, if they exist. The surplus will be used on non-hospitalized victims.

5) Treatment is limited to this one area, and surrounding areas are not yet being treated.

6) The birthrate in the area is such that the deaths due to malaria do not significantly lower the population, and it remains at approximately 100,000 throughout the years.

7) The costs quoted in the program are based on data from the World Health Organization, and include administration and personnel costs.

8) The actual effectiveness of any treatment option cannot be 100%. This means, for example, that a 100% mosquito-eradication program will not wipe out 100% of the mosquitoes. This is so for a variety of reasons: some of them have a resistance to insecticides; human errors; and other factors. In a similar fashion the actual effectiveness is reduced in the other options.

9) If drugs are not used in the year ordered, there is a 25% loss (per year) due to pilferage, chemical breakdown, etc.

IV. NOTES ON RUNNING THE PROGRAM

You should not have any difficulty using the MALAR program. However, there are a few points that should be mentioned before you begin.

1) When you have finished putting in all your decisions, the computer will print out a table which will show the results of your five-year plan. The first line in the table is printed with a "0" in the column headed "year." This simply refers to the time before you began to implement your eradication plan. The other statistics in that line tell you the specific number of sick and dead at the time you came into the area to begin your eradication plan.

2) When the computer prints out the results of your five-year plan, the number of sick specified for any one year refers to the number of sick at the end of that year. The number of deaths printed refers to the actual number of deaths which occurred during that year.

V. COMPUTER LABORATORY MANUAL

A. Exploration Exercises: Effects of the Treatment Options

As you work with the MALAR program, it will be helpful for you to have some notion of what effects each treatment option has. Use the MALAR program without a budget restriction (Version 2) and try to determine what effect is had by each treatment option when it is used alone.

Run the program several times until you can answer the following questions:

1) Can the epidemic be eradicated successfully by using only one of the four options for all five years? If so, which one? If not, describe what happened when each option was used alone and try to explain the results.

2) Which of the four treatment possibilities was most effective when used alone in reducing both the number of sick and the number of dead? Which was least effective? Can you think of some reasons for these results?

Curative activities refer to those activities directed at the cure of malaria victims. *Preventive* activities are those which are intended to prevent those who are still healthy from getting malaria. Use the computer program without a financial limitation to help you answer the following questions.

3) Can the malaria epidemic be successfully eradicated by using only *curative* measures, that is, by just setting up hospitals and administering drugs to the ill? Describe the results of using such a plan, and try to explain your results.

4) Can the malaria epidemic be eradicated by using only *preventive* measures, that is, by just using mosquito control and immunization programs? Describe the results of using such a plan and try to explain your results.

5) Compare the results you got in 1) with those you got in 3) and 4). Was the combined use of hospital beds and drugs for the ill more effective than the use of hospital beds alone or drugs alone? Why or why not?

6) Once again comparing the results of 1) with those of 3) and 4), was the combined use of a mosquito-control plan and an immunization plan more effective than the use of either plan alone? Why or why not?

7) Using the information you got from the previous exercises, try to devise an eradication strategy. Do not use a budget restriction with MALAR (Version 2); simply try to wipe out the epidemic in five years. Spend as much money as you need. Record your strategy on a *PLAN OF ACTION* sheet, and describe the results obtained when you implemented it using MALAR. Below are the instructions for using the plan sheet on the next page.

DIRECTIONS FOR USING THE *PLAN OF ACTION* CHART

S-T-E-P-S

1. Check those treatments you wish to use in Column A.

   NOTE: Select only 1 type of pesticide (if you elect to control the mosquitoes).

2. Look at the figures in Column B. They indicate the cost of each treatment program.

3. For those programs checked in Column A, indicate the appropriate number of field hospitals, drugs for the sick, and preventive drugs which you want to use as well as the per cent of mosquitoes you wish to eliminate each year. Place your values in Column C.

4. In Column D, indicate the total number of years you wish to carry out each treatment program you selected in Column A.

5. Fill in the appropriate values in Column E. Each value is calculated by multiplying the appropriate values in column (B) X (C) X (D).

   EXAMPLE: If you select to use 1 hospital for 2 years, the value in Column E would be: 2000 X 1 X 2 = $4000.

6. Total up the values placed in Column E and put the answer in the blank at the bottom of the sheet.

7. Make sure that the grand total does not exceed the $500,000 limit. If it is greater than $500,000, you must alert your control program until it fits within the limits of the budget.

Use a different chart for each 5-year period.

You may attach the computer-printed results to the back of the *PLAN OF ACTION* chart.

PLAN OF ACTION

A	B	C	D	E
TREATMENT PROGRAM________	COST PER UNIT	NUMBER UNITS or PERCENT EFFICIENCY	TOTAL YEARS IN EFFECT	TOTAL COST
FIELD HOSPITALS________	2000	X____hospitals/year	X____years	= $______
DRUGS FOR SICK________	2	X____doses/year	X____years	= $______
MOSQUITOES Pesticides (choose one): a) DDT________ b) Malathion______ c) Propoxur______	 750 2310 6375	X____% mosquitoes killed	X____years	= $______
PREVENTIVE DRUGS________	0.72	X____doses/year	X____years	= $______

(Amount allowed = $500,000 if following budget)

Grand Total = $______

RESULTS: ____

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8) If your strategy did not work, try others until you find an effective one. Record it here and describe the results you obtained when you used it with MALAR.

PLAN OF ACTION

A	B	C	D	E
TREATMENT PROGRAM________	COST PER UNIT	NUMBER UNITS or PERCENT EFFICIENCY	TOTAL YEARS IN EFFECT	TOTAL COST
FIELD HOSPITALS________	2000	X____hospitals/year	X____years	= $_______
DRUGS FOR SICK________	2	X____doses/year	X____years	= $_______
MOSQUITOES Pesticides (choose one): a) DDT________ b) Malathion______ c) Propoxur______	 750 2310 6375	X____% mosquitoes killed	X____years	= $_______
PREVENTIVE DRUGS________	0.72	X____doses/year	X____years	= $_______

(Amount allowed = $500,000 if following budget)   Grand Total = $_______

RESULTS: ____

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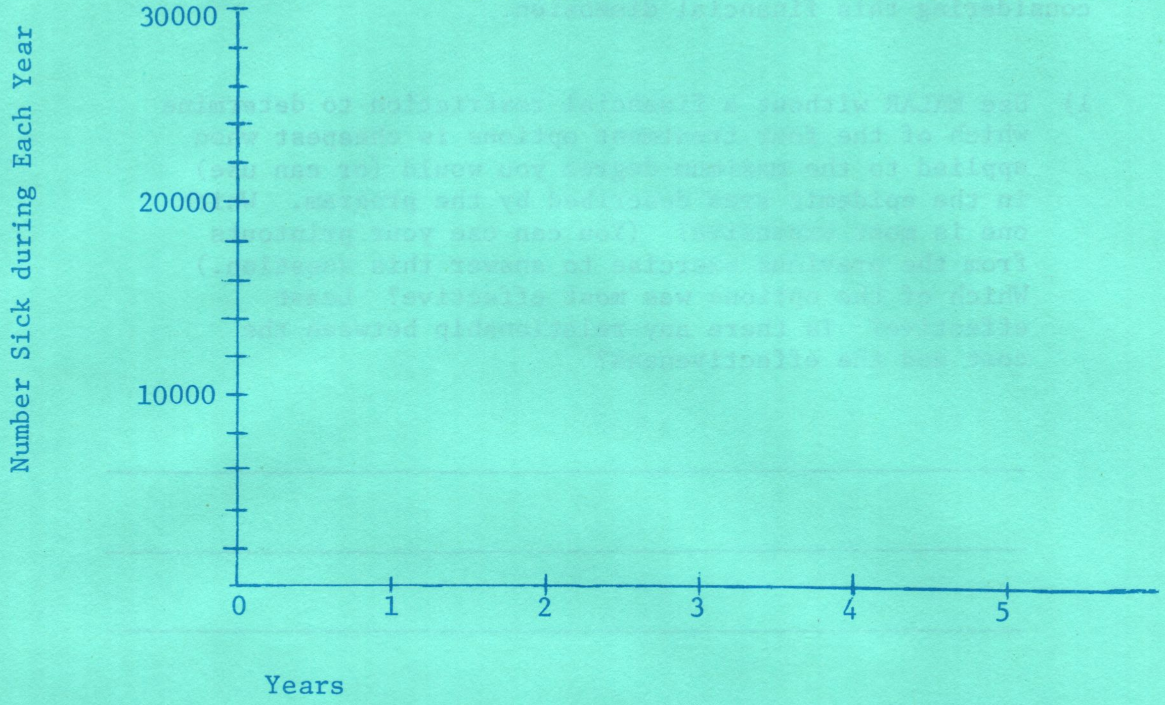
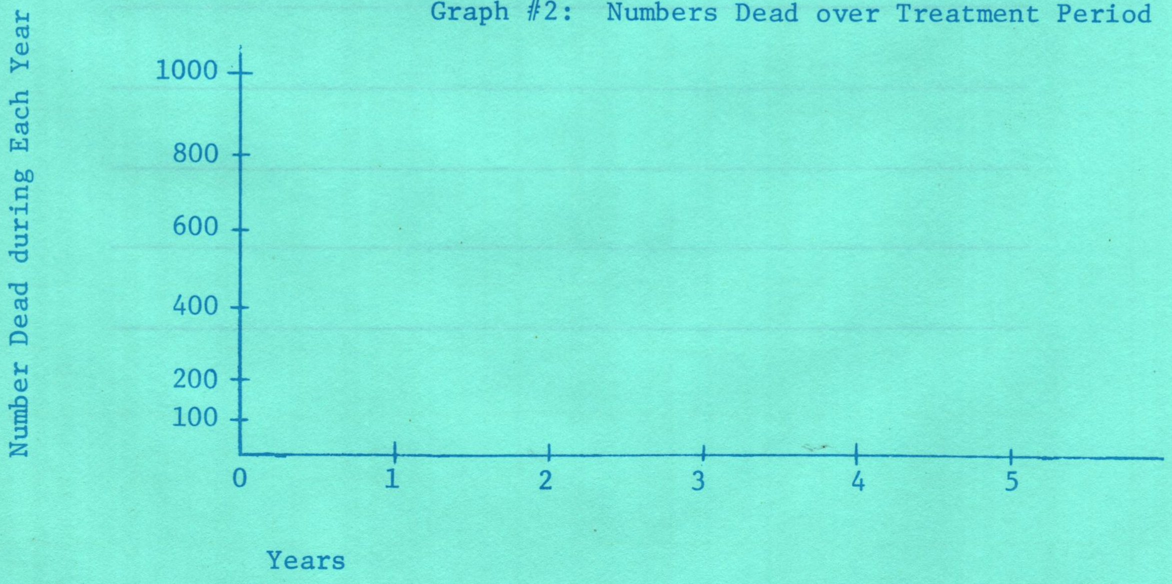
9) Using the axes below, make graphs which picture the results of your best five-year strategy. Use the data from your printouts.

Graph #1: Numbers Sick over Treatment Period



Graph #2: Numbers Dead over Treatment Period



Total Cost of Program: $______________

B. Exploration Exercises: Costs

In the-previous exercises, you have not been concerned with costs. As you know, however, cost is a very real factor in any health maintenance effort. In the following exercises, you will be considering this financial dimension.

1) Use MALAR without a financial restriction to determine which of the four treatment options is cheapest when applied to the maximum degree you would (or can use) in the epidemic area described by the program. Which one is most expensive? (You can use your printouts from the previous exercise to answer this question.) Which of the options was most effective? Least effective? Is there any relationship between the cost and the effectiveness?

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2) Keeping in mind the costs you found in the last question, devise a control strategy to use with a budget restriction of $500,000. Record your strategy here and describe the results obtained when you implemented it using MALAR. (See instructions, p. 8 for help using the chart.)

PLAN OF ACTION

A	B	C	D	E
TREATMENT PROGRAM ________	COST PER UNIT	NUMBER UNITS or PERCENT EFFICIENCY	TOTAL YEARS IN EFFECT	TOTAL COST
FIELD HOSPITALS ________	2000	X ____ hospitals/year	X ____ years	= $ ________
DRUGS FOR SICK ________	2	X ____ doses/year	X ____ years	= $ ________
MOSQUITOES Pesticides (choose one): a) DDT ________ b) Malathion ________ c) Propoxur ________	 750 2310 6375	X ____ % mosquitoes killed	X ____ years	= $ ________
PREVENTIVE DRUGS ________	0.72	X ____ doses/year	X ____ years	= $ ________

(Amount allowed = $500,000 if following budget)

Grand Total = $ ________

RESULTS: ____

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3) If your plan in 2) did not work, try others until you find an effective one. Describe it here and the results obtained.

PLAN OF ACTION

A	B	C	D	E
TREATMENT PROGRAM________	COST PER UNIT	NUMBER UNITS or PERCENT EFFICIENCY	TOTAL YEARS IN EFFECT	TOTAL COST
FIELD HOSPITALS________	2000	X_____hospitals/year	X_____years	= $________
DRUGS FOR SICK________	2	X_____doses/year	X_____years	= $________
MOSQUITOES Pesticides (choose one): a) DDT________ b) Malathion________ c) Propoxur________	750 2310 6375	X_____% mosquitoes killed	X_____years	= $________
PREVENTIVE DRUGS________	0.72	X_____doses/year	X_____years	= $________

(Amount allowed = $500,000 if following budget)

Grand Total = $________

REMARKS:____

4) How did the best malaria eradication strategy you found for working with a budget differ from the best one you found for working without a budget?

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5) If the effective plan you found in 3) used a mosquito-control measure, run the program using exactly the same plan but without the mosquito-control measures. How do the costs compare? How do the results compare?

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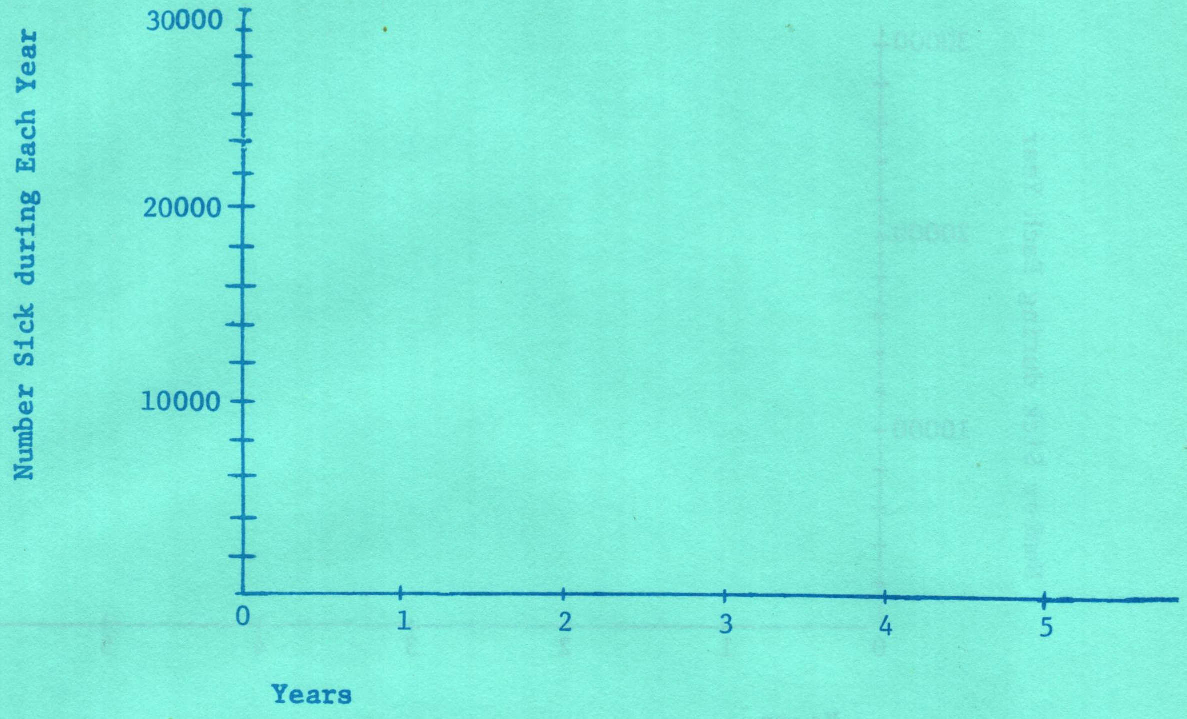
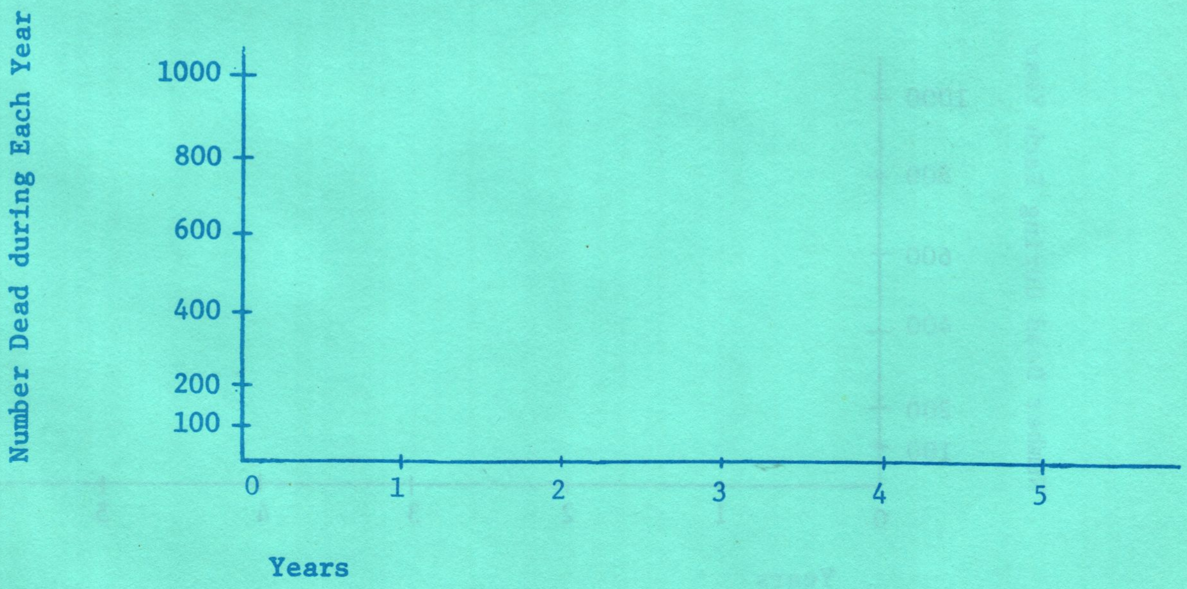
6) Run the program again using the best plan you found in 3), but this time eliminate the preventive-drug program instead of the mosquito-control measures. How do the costs compare? How do the results compare?

7) Using the three sets of axes following, make graphs that picture your results from 4), 5), and 6) above. Use the data from your printouts.

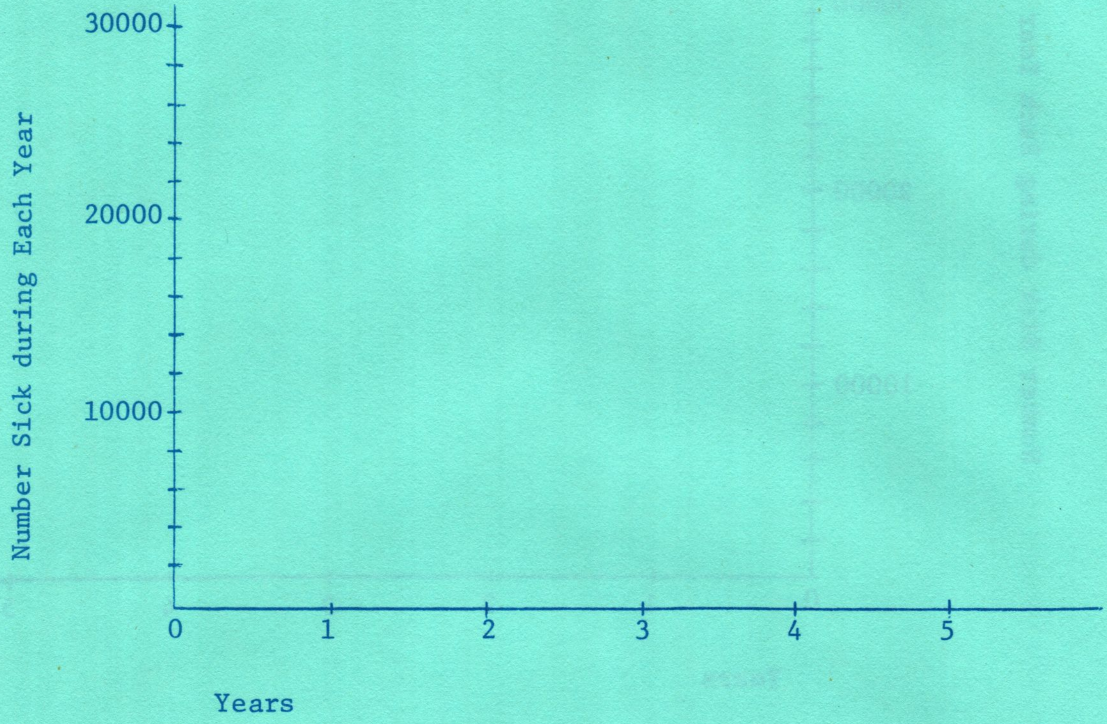
Graph Set #1: Results of Malaria Eradication Plan[from 4)]

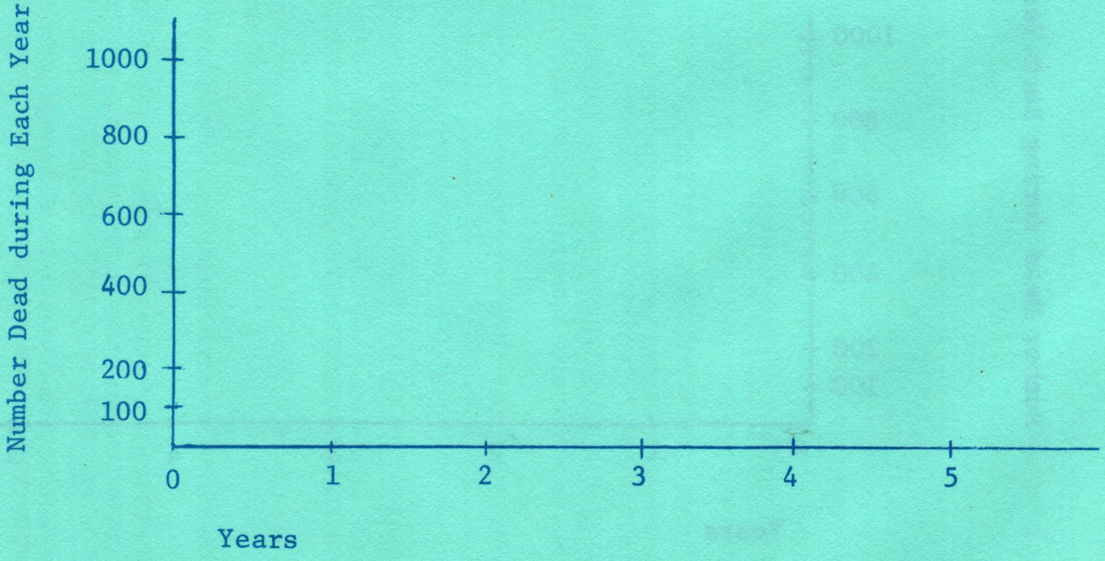




Total Cost of Program: $______________

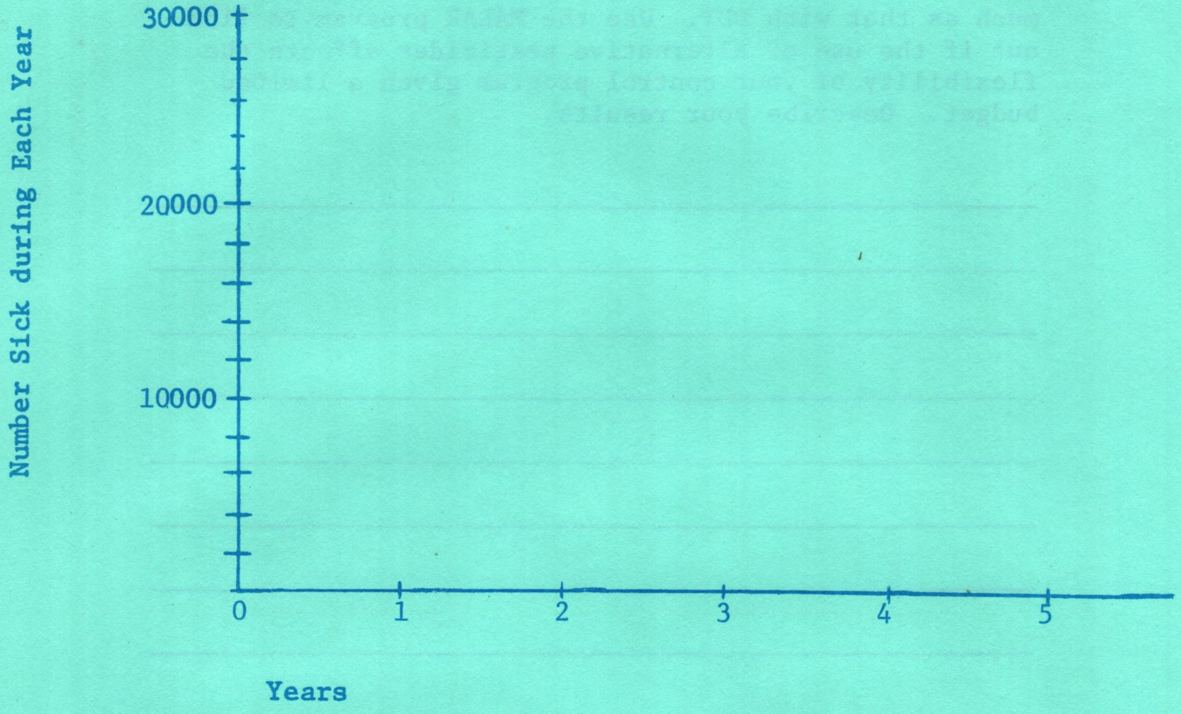
Graph Set #2: Results of Malaria Eradication Plan Without Mosquito Control [from 5)]

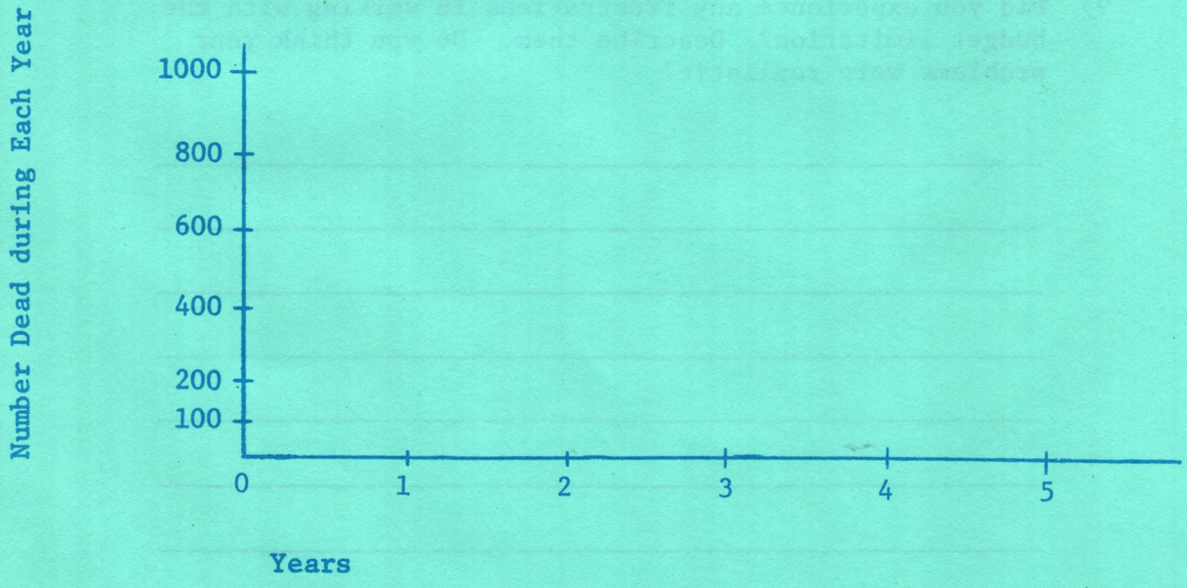




Total Cost of Program: $__________

Graph Set #3: Results of Malaria Eradication Plan without Preventive Drugs [from 6)]





Total Cost of Program: $________________

8) Ecologically speaking, DDT is an undesirable pesticide; however, the other two pesticides offered by MALAR are more expensive. A full treatment with malathion would cost about 3 times as much as a full treatment with DDT. A full treatment with propoxur would cost 8½ times as much as that with DDT. Use the MALAR program to find out if the use of alternative pesticides affects the flexibility of your control program given a limited budget. Describe your results.

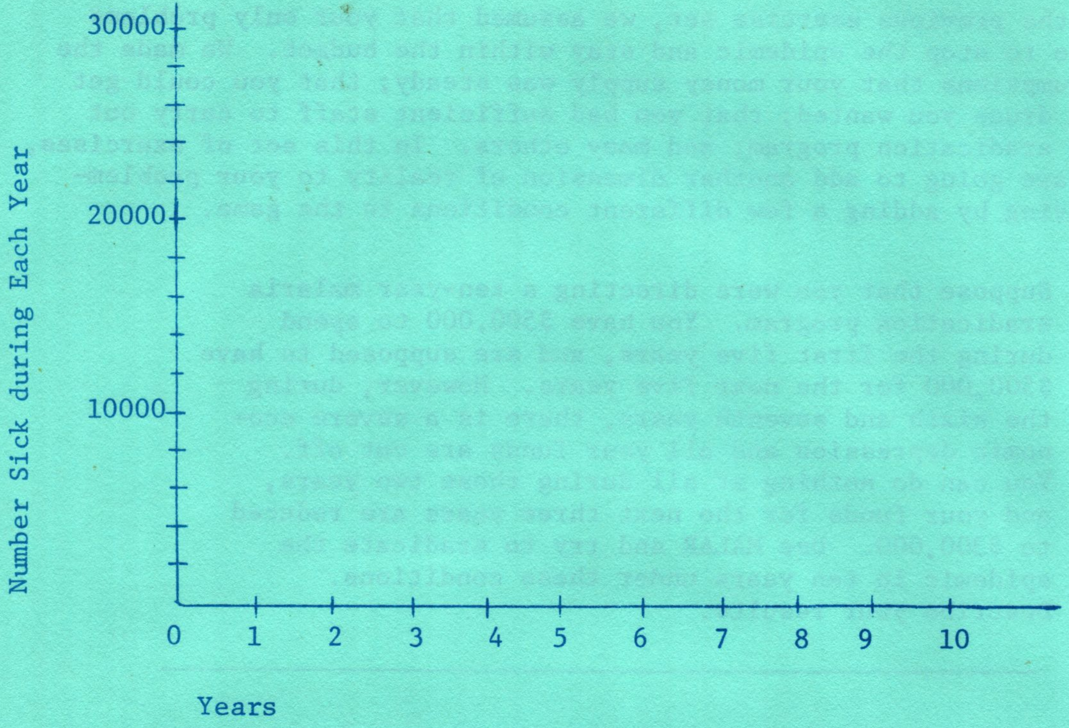
9) Did you experience any frustrations in working with the budget limitation? Describe them. Do you think your problems were realistic?

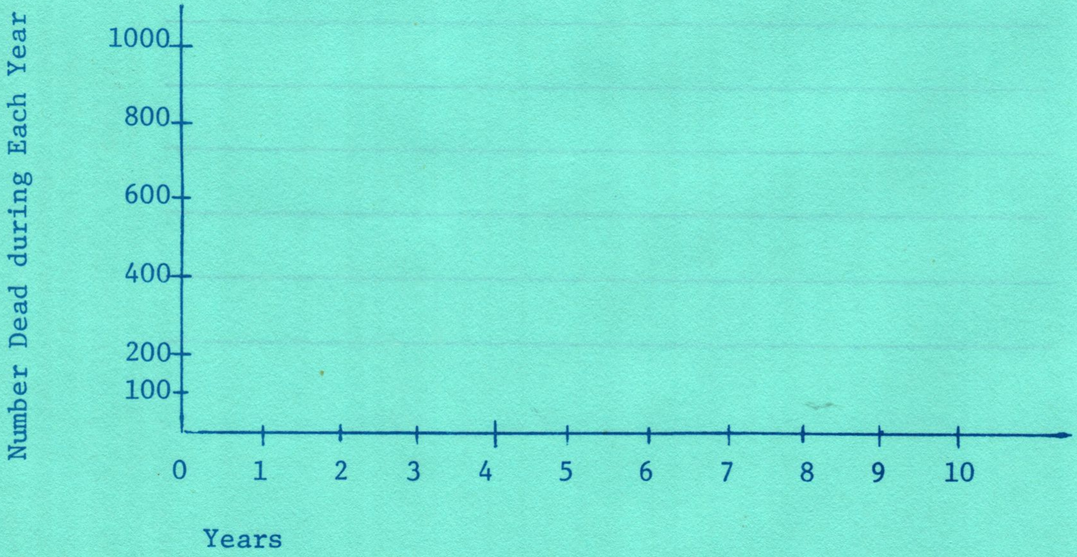
C. Exploration Exercises: Complications

In the previous exercise set, we assumed that your only problems were to stop the epidemic and stay within the budget. We made the assumptions that your money supply was steady; that you could get the drugs you wanted; that you had sufficient staff to carry out the eradication program; and many others. In this set of exercises, we are going to add another dimension of reality to your problem-solving by adding a few different conditions to the game.

1) Suppose that you were directing a ten-year malaria eradication program. You have $500,000 to spend during the first five years, and are supposed to have $500,000 for the next five years. However, during the sixth and seventh years, there is a severe economic depression and all your funds are cut off. You can do nothing at all during those two years, and your funds for the next three years are reduced to $300,000. Use MALAR and try to eradicate the epidemic in ten years under these conditions. Describe your results.

Make two graphs which depict the situation over the 10 years:

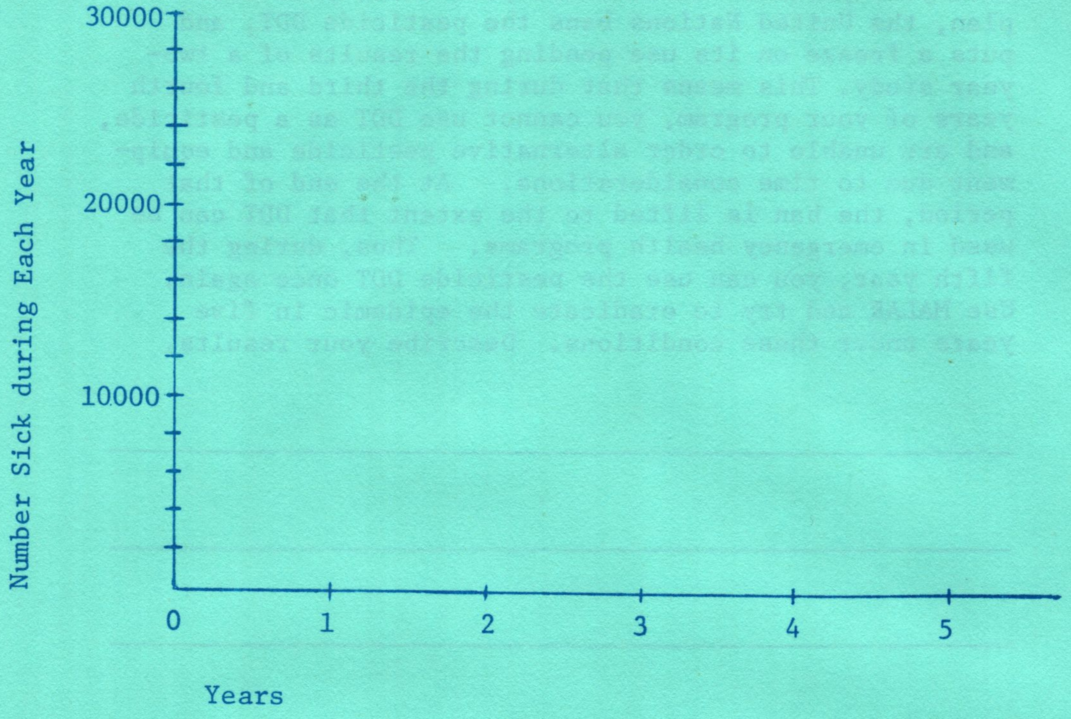


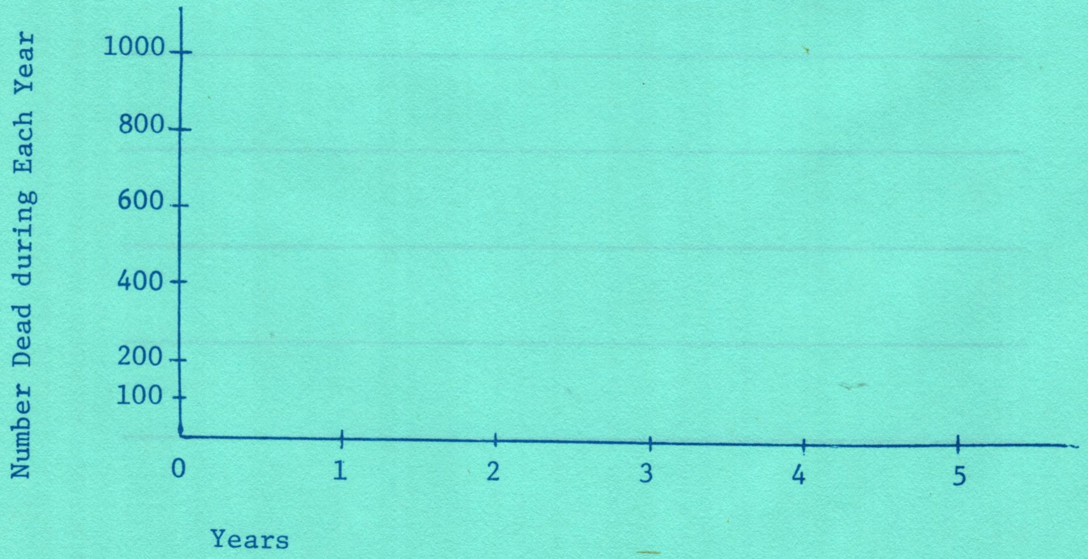


Total Cost of Program: $____________

2) You have $500,000 to use for malaria eradication over a five-year period. Just before your third year into the plan, the United Nations bans the pesticide DDT, and puts a freeze on its use pending the results of a two-year study. This means that during the third and fourth years of your program, you cannot use DDT as a pesticide, and are unable to order alternative pesticide and equipment due to time considerations. At the end of that period, the ban is lifted to the extent that DDT can be used in emergency health programs. Thus, during the fifth year, you can use the pesticide DDT once again. Use MALAR and try to eradicate the epidemic in five years under these conditions. Describe your results.

Make two graphs to depict the situation over the five-year period:

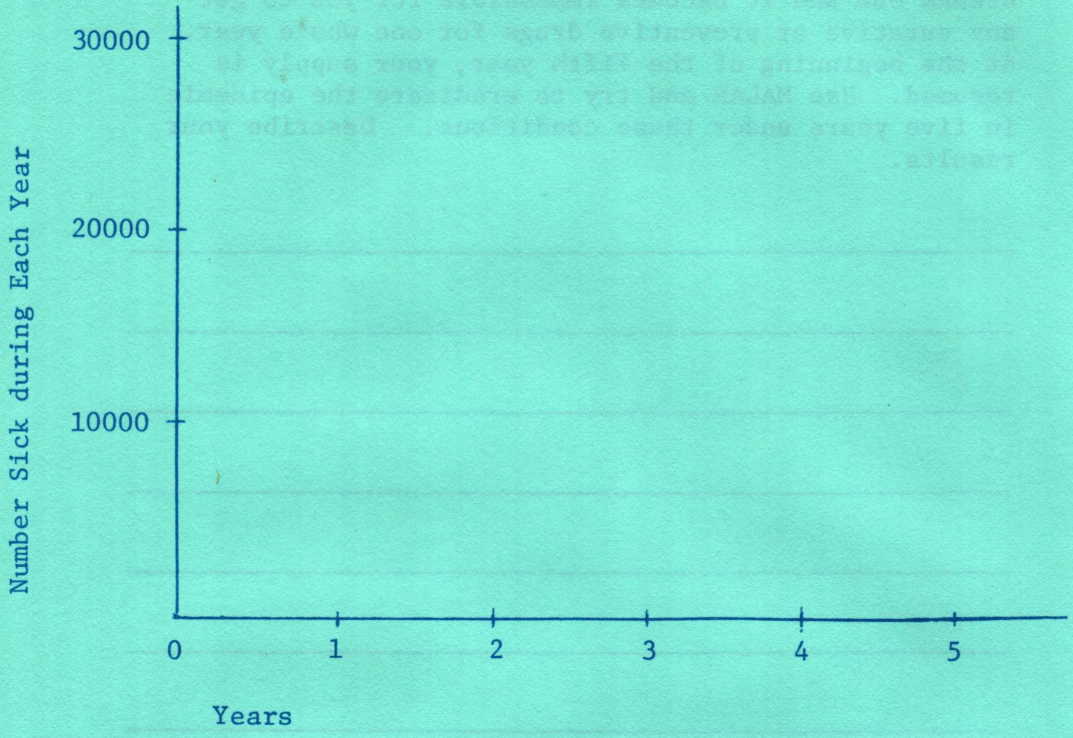


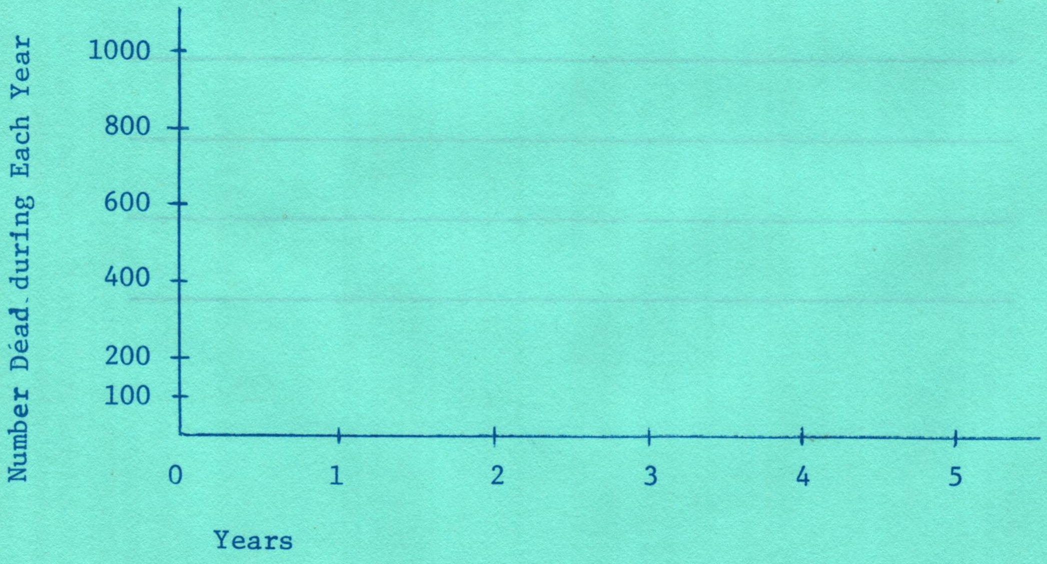


Total Cost of Program: $______________

3) You are directing an eradication program with a budget of $500,000 for five years. After three years, a war breaks out and it becomes impossible for you to get any curative or preventive drugs for one whole year. At the beginning of the fifth year, your supply is resumed. Use MALAR and try to eradicate the epidemic in five years under these conditions. Describe your results.

Make two graphs which depict the situation over the five years.





Total Cost of Program: $__________

PLAN OF ACTION

A	B	C	D	E
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PREVENTIVE DRUGS_________	0.72	X_____doses/year	X_____years	= $________

(Amount allowed = $500,000 if following budget)

Grand Total = $________

PLAN OF ACTION

A	B	C	D	E
TREATMENT PROGRAM__________	COST PER UNIT	NUMBER UNITS or PERCENT EFFICIENCY	TOTAL YEARS IN EFFECT	TOTAL COST
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(Amount allowed = $500,000 if following budget)

Grand Total = $________

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MOSQUITOES Pesticides (choose one): a) DDT____________ b) Malathion_______ c) Propoxur_______	 750 2310 6375	X_____% mosquitoes killed	X_____years	= $________
PREVENTIVE DRUGS___________	0.72	X_____doses/year	X_____years	= $________

(Amount allowed = $500,000 if following budget)

Grand Total = $________